



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

# JOURNAL

OF THE

## AMERICAN WATER WORKS ASSOCIATION

The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

VOL. 2

MARCH 1915

No. 1

---

### THE YONKERS WATER SUPPLY AND ITS FUTURE DEVELOPMENT

BY D. F. FULTON\*

The city of Yonkers, the sixth city in respect to population, of the state of New York, adjoins New York City on its northerly line. It extends from the Hudson River, on which it has a frontage of about four and one-half miles, easterly to the Bronx River and occupies the southwesterly corner of Westchester County. In common with the remaining portion of the southerly part of the county it felt, during 1910 and 1911, the pinch of poverty, as regards water supply, a condition made acute by the unusual dryness of those years together with the ever increasing demands on the supply due to a rapid growth in population and to the increase in consumption by new or expanding manufacturing industries.

The rainfall records of the Water Bureau, continuous since 1878, with the observing station less than one-half mile from the storage reservoir indicates the rainfall of 1910 to be eighteen inches below the average for thirty-three years and that of 1911 to be eleven inches below the average for thirty-four years.

For some time past, it has been plain to the city authorities that the present supply would soon be insufficient to meet requirements and various measures have been adopted to conserve and augment the supply and to minimize waste. These measures although fairly

\*City Engineer, Yonkers, N. Y.

successful were not, nor were they expected to be sufficient to relieve the situation for any length of time and Yonkers now proposes to obtain water to meet estimated demands for a period of from fifteen to twenty years.

Before describing the method by which it is proposed to obtain this increase, a brief historical outline of the origin and growth of the present supply and works will perhaps be interesting.

Topographically, Yonkers is divided into a series of ridges and valleys extending in a generally north and south direction. The northerly part of the city is traversed by three streams, the largest and most westerly of which is the Saw Mill or Nepperhan River which in former years was the source of power for many mills in Yonkers and which when it reaches the center of the city flows westerly into the Hudson River.

Occupying the next valley to the east of the Saw Mill River and separated from it by a high narrow ridge, is the Sprain. East of the Sprain and similarly separated from it, lies the Grassy Sprain. Within the city, however, they meet and flow in a southeasterly direction into the Bronx River.

In 1876 there was constructed what has generally been known as our Grassy Sprain Supply.

A canal, part of the original works, diverts the flowage of the upper Sprain into the Grassy Sprain and this combined catchment area amounts to  $4\frac{1}{2}$  square miles.

On the Grassy Sprain a storage reservoir was formed by the construction of an earth dam with flowline at about elevation 118, the capacity of which was 440 million gallons. Water was pumped to the small Lake Avenue Reservoir and from it flowed by gravity into the distributing mains.

About 1885, a tank or tower was constructed near the Lake Avenue reservoir, a pump installed, and the water repumped to the tower. This arrangement with an additional tower and some enlargements constitutes our high service system today.

By 1895, the draught had become so heavy that the supply was somewhat augmented by driving, in the Saw Mill River Valley, some 12 to 15 tubular wells. These wells averaged about 40 feet in depth, tapping the underground water stored in the sandfilled valley. A pumping plant was installed at the site of these wells and the water pumped directly into mains. This station has come to be known as our tubewell or Nepperhan Pumping Station.

At this time Fortfield Distributing Reservoir with flowline at approximately the same elevation as the Lake Avenue Reservoir but with a capacity of 60 million gallons, was constructed.

For some time additional water, amounting to about a million gallons daily, was thus obtained, but the level of the ground water was in the meantime lowered about 28 feet so that by 1903 the amount thus secured had become somewhat less.

In 1903, the supply was further increased by the construction, at the site of the Tube Wells Pumping Station, of two filters of one-half acre each. These filters were of the open, slow sand type and were designed to help out during the summer months.

The filters took the raw water of the Saw Mill River, and for ordinary stages of the river, and in open weather answered their purpose well. They had a combined rated capacity of 3 million gallons daily.

Prior to 1905 and during the spring freshets, considerable water went over the spillway of the Grassy Sprain Dam. In order to avail ourselves of this water the dam was raised about 12 feet, which added height increased the capacity from 440 to 960 million gallons. In 1909 two additional filters of three-quarters of an acre each, of the covered slow sand type and with a combined rated capacity of 4.5 million gallons, were completed.

To permit of the temporary cutting out of a bed, for repairs or cleaning, and in order to secure additional capacity two more filters of the same type and size as those last constructed have just been added to the plant. This brings the total to 4 acres of filters with rated capacity of 12 million gallons daily on the basis of 3 million gallons per acre per day.

In the summer months, when the draught on the supply is heavy, we have an ample capacity in the filtration plant, but unfortunately not sufficient water in the stream.

It is not possible, within reasonable limits of cost, to provide storage at the site of the filters, and as a consequence raw water has to be admitted directly to them. In times of flood, when there is an abundance of water in the Saw Mill River, it unfortunately carries a large amount of matter in suspension. At such times they have to be closed down, and considerable water passes by unused.

These were the conditions with which we faced the unusually dry years of 1910 and 1911.

While Yonkers has been particularly fortunate during the past

four years, the situation at that time was one that required immediate relief. It also emphasized the necessity of developing a plan that would embrace storage sufficient to carry us over at least one dry year, and at the same time to provide a supply ample to meet requirements for a term of years.

In December, 1910, a Joint Water Supply Committee consisting of councilmen and citizens was appointed by the mayor. The committee, after resolving itself into a working body, retained as consulting engineers, to examine into and report on an increased water supply, Messrs. Hazen and Whipple.

As a temporary alleviation of the conditions then existing it was recommended by them, that, inasmuch as all the water reaching the filters was not being used, the rate of filtration be increased to such an extent that practically the entire draught, when possible, should be taken from them.

With the use of hypochlorite in conjunction with the filters it was recommended that the old rate of 3 million gallons per acre, daily, could be safely increased at least 50 per cent, and when this practice became effective the Grassy Sprain Reservoir, being relieved of the draught, began to fill and immediate danger was averted.

In November, 1911, the consulting engineers submitted their report which in substance covered the recommendation that an increased supply of water for the city of Yonkers was to be most economically obtained by developing up to about ultimate capacity, our present sources.

From what has heretofore been said it will be remembered that Yonkers is now obtaining water from three separate sources.

- (1) The Grassy Sprain Supply.
- (2) The Saw Mill River or Filtered Supply.
- (3) The Tube Well Supply.

The amount of water, however, obtained from this last source is very small, almost negligible, so that for all practical purposes our present supply will be considered as from Grassy Sprain and Saw Mill River.

The Grassy Sprain supply, with the raising of the dam in 1905, increasing the storage from 440 to 960 million gallons, saw that supply developed to about its ultimate capacity.

It must be inferred, then, that the development to which reference has heretofore been made means the development of the Saw Mill River supply and in fact that is the substance of the report.

## THE REPORT

As an index to the size of works probably required, the population and consumption of the city for the years 1915 to 1930 has been estimated and together with population and consumption for the years 1880 to 1910 is shown in the following table.

<i>Year</i>	<i>Population</i>	<i>Million gallons per day</i>	<i>Gallons per capita</i>
1880.....	18,892	0.86	46
1890.....	32,033	2.17	68
1900.....	47,931	3.25	68
1910.....	79,803	8.20	103
<i>Estimated</i>			
1915.....	101,000	10.2	100
1920.....	129,000	12.9	100
1925.....	160,000	16.0	100
1930.....	197,000	19.7	100
1935.....	240,000	24.0	100

To many only slightly familiar with conditions in Westchester County it might appear that a supply sufficient to meet the requirement for the year—say—1930 could readily be obtained in the northern part of the county.

A study of the map herewith shown, however, will indicate pretty clearly that New York City has been first on the ground, and when a search is made for a supply of this size it is not quite such a simple problem as at first blush might appear.

In the investigation looking to an outside supply a canvass was made for a considerable distance north of Yonkers of all available catchment areas. Those of Sprout Brook, Oscowanna Brook and Peekskill Creek were considered as affording the most economical sources from which a considerable supply of water could be obtained.

By the construction of dams on Sprout Brook and Peekskill Creek, it was set forth that a supply of 40 million gallons per day could be delivered by gravity at an approximate cost of \$9,500,000 or at a cost of \$234,000 per million gallons daily.

Inasmuch as Peekskill has the first right to the water of Peekskill Creek and Oscowanna Brook, and because of the large amount of capital required for the development, this source was not favorably accepted by the committee.

However, should the future make it desirable for a Metropolitan District for lower Westchester County, this would afford an admirable supply sufficient for a population of 400,000 people.

In general the plans submitted by Hazen and Whipple and adopted by the Joint Water Supply Committee provides for obtaining an increased supply of water from the Saw Mill River. This is to be accomplished by:

(1) Control of flood flows of that river, by enlarging the present Grassy Sprain Storage Reservoir, and the construction of two additional reservoirs.

(2) By the filtration of all water used by the city of Yonkers.

#### CONTROL OF FLOOD FLOWS OF SAW MILL RIVER

Reference is again called to the map on which is shown a proposed reservoir at East View. Behind this site is a catchment area of about 12 square miles. It is proposed to build here an earth dam, 20 feet wide on top, maximum height 47 feet, 400 feet long at the flowline and provided with gate house and overflow.

With the flowline of this reservoir at elevation 230 and with a capacity of 560 million gallons it is proposed to arrest the floods of the upper area and by the operation of regulating gates this stored water will be passed down the stream to Woodlands Lake, an existing artificial lake with spillway at elevation 155, where an intake is to be constructed.

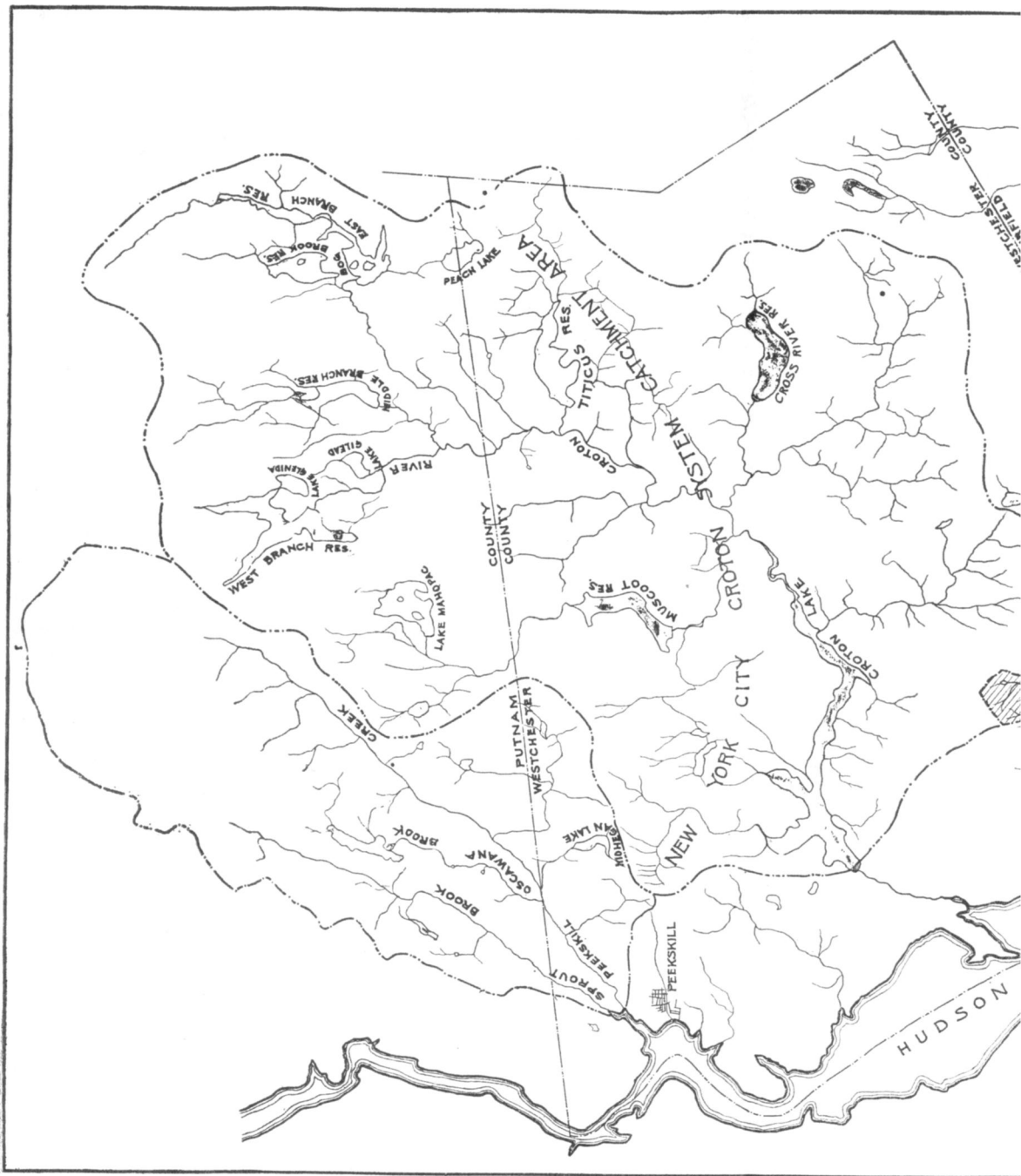
From Woodlands Lake a 72-inch aqueduct and tunnel will conduct the flowage through the ridge into the upper Sprain.

It is to be here noted, that the water of the Saw Mill River, a tributary of the Hudson, is to be diverted to the Sprain, a tributary of the Bronx.

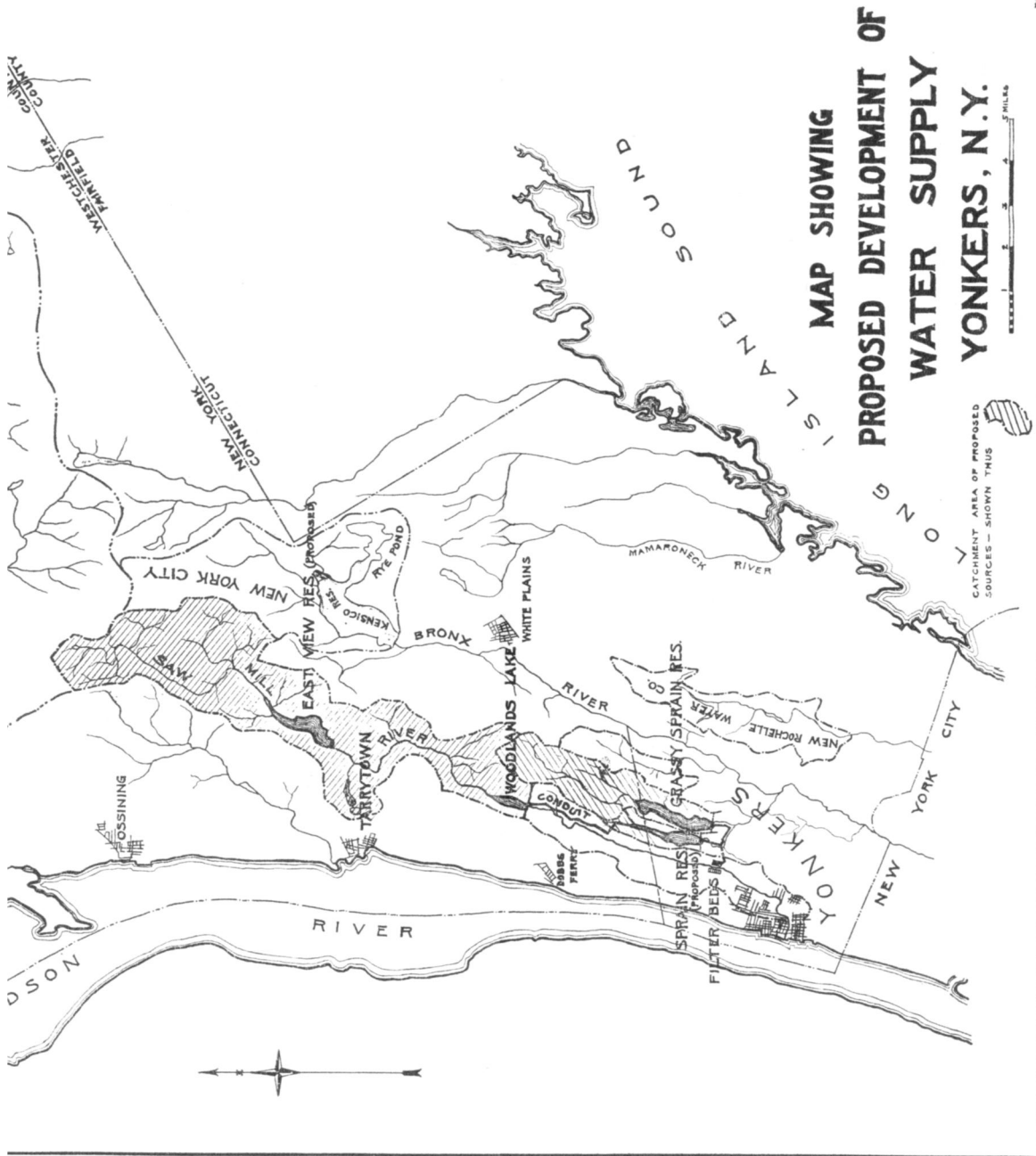
In the lower Sprain Valley it is proposed to form a reservoir by constructing an earth dam 50 feet high and 350 feet long. The reservoir will have a flowline at elevation 147 with the top of the dam at elevation 155.

The Sprain Reservoir, it will be noted from the map, lies directly west of the Grassy Sprain Reservoir, which is to be enlarged by the construction of an earth dam 40 feet higher than the present one, and about 350 feet down stream from it. It will be about 24 feet wide on top and 1070 feet long.

Underlying the present dam, preliminary borings indicate rock at a depth of 90 feet below the brook. The Rock Valley is wide so that there is a large section of material overlying it. This material is largely sand of varying degrees of coarseness, much of it is so coarse as to carry water freely.







**MAP SHOWING  
PROPOSED DEVELOPMENT OF  
WATER SUPPLY  
YONKERS, N.Y.**

CATCHMENT AREA OF PROPOSED  
SOURCES - SHOWN THUS

0 1 2 3 4 MILES

For the new dam, it is proposed to provide a cut-off for this underground flowage. It has been suggested that this can be done either by driving steel sheet piling to rock or in the deeper part of the valley by sinking a connected series of caissons and filling them with grout or concrete.

A 6-foot tunnel is to be driven through the ridge between the two reservoirs which will permit filling the Grassy Sprain Reservoir up to elevation 147 by gravity.

The flowline of the enlarged Grassy Sprain Reservoir will be at elevation 170 and to fill the upper 23 feet it is proposed to install a pump at the entrance of the tunnel to be operated by an electric motor, the current for which will be furnished by a generator at the Filter Bed Pumping Station.

Water will be drawn by gravity from either or both of these reservoirs through 48-inch lines to the filter beds. Under ordinary operations the water will be drawn from the Grassy Sprain Reservoir.

It will be noted that by this arrangement no raw water will be taken to the filters but water, only after a considerable period of settling, storage and bleaching both in the Sprain and Grassy Sprain Reservoirs, will be admitted to them.

The filtered water will be pumped directly into the mains and also to the Fortfield Reservoir. This is an open reservoir with a capacity of about 60 million gallons, divided into two equal parts by a masonry wall. It is part of the general scheme to raise and cover this reservoir. Raising has been suggested because it can be done with but little additional cost in connection with the covering.

With the completion of the above outlined works, with a total catchment area of about 24 square miles, it is somewhat conservatively estimated that a supply of about 18 million gallons per day in an ordinary dry year will be obtained. In other years it is expected that from 20 to 22 million gallons daily will be obtained.

With all reservoirs filled we will have 5700 million gallons of water in storage, an amount sufficient for a year's supply at 18 million gallons per day.

This storage will be distributed as follows:

	<i>Gallons</i>
East View Reservoir.....	560,000,000
Sprain Reservoir.....	380,000,000
Grassy Sprain Reservoir.....	4,700,000,000
Fortfield.....	60,000,000
Total.....	5,700,000,000

The estimated cost of the works by which it is proposed to obtain an additional 10 million gallons per day is \$3,073,000 which includes \$1,000,000 for land.

This is at the rate of \$307,000 per million gallons daily, a figure somewhat high, but which is made so, at least in part, by the estimated cost of land to be acquired. Also included in this cost, however difficult to determine, is the value both from a sanitary and commercial view point, of filtering only stored and settled water, as compared with the filtering of raw water, the method in use today.

### DISCUSSION

MR. EDWARD L. PEENE: You have heard the paper, as well prepared as could be, on the question of our future water supply, and there seems to be nothing further to add. The speaker simply takes care of the maintenance of our water system, and he has all he can do to take care of that. You will notice that this increased supply is to be furnished at an estimated amount of 18,000,000 gallons per day. The present consumption is about 10,000,000 gallons per day. The population is about 100,000, and this is quite a small amount for such a large city. You know that Yonkers is about 100 per cent metered, and that is why we are able to keep down the amount of water used in the city. Our per capita last year ran close to 98, but, deducting the manufacturing, brings the domestic consumption to 29 gallons per day. Our average use per day for this year, to date, is 7,500,000 gallons, which is due to a completely metered system, and all water pumped being measured by a Venturi meter in place of plunger displacement as heretofore.

MR. ALLEN HAZEN: That is an interesting statement on meters. Can you tell us what per cent of the output is accounted for by your meters?

MR. EDWARD L. PEENE: About 60 to 65 per cent.

MR. JOHN C. TRAUTWINE, JR.: To one who, like the speaker, hails from one of New York's southern suburbs, where the percentage of taps metered approximates zero as a limit, and where the daily per capita draft is something like 180 gallons, or from two

to four times what it has any excuse for being, it is refreshing (if also humiliating) to learn, from Mr. Peene's discussion, that, in the northern suburb of Yonkers, where the percentage of taps metered is 100, the domestic draft is only 29 gallons per capita per day, less than 16 per cent of Philadelphia's, and yet ample; and that the city has been able to get along with a water supply which, under Philadelphia conditions, would have been ridiculously inadequate.

Only today, in this room, a fellow suburbanite, who lives in the fourth story of the Philadelphia Engineers Club, said that, in spite of a pumpage of say 180 gallons per capita per day, he could be sure of getting water from the tap on that floor only when, as happened this morning, he was forced to rise with or before the lark.

For a generation and more those in charge of Philadelphia's water supply have struggled for the introduction of meters, recognizing this as the key, the sufficient key, and the only key, to all our water troubles; and our City Charter expressly places the "Water Works . . . under the direction, control, and administration of the department of public works," expressly forbidding the City Councils to direct or interfere with the exercise of the Department's executive functions, and expressly commanding the City Councils to provide for the proper conduct of the works by the Department.

But, unfortunately, these provisions of the City Charter are a dead letter. The Councils usurp the executive functions of the Department; and, the water meter being practically unknown, and therefore unpopular, in Philadelphia, our city remains in the ranks of the back numbers. It is needless to say that she pays dearly for her backwardness.

Like its predecessors, the present reform administration, in its early days, vigorously espoused the restriction of waste by means of water meters. For the enlightenment of our unhappy people, it set up and maintained, in the City Hall courtyard, an exposition with a screen for lantern slides.

In his report for 1912 Director Cooke said:

We are undoubtedly fortunate in lying at the junction of two such magnificent waterways as the Delaware and Schuylkill . . . but it is not wise to allow this good fortune to be given as an excuse for a profligate waste of water, a waste certainly amounting to one-half of all we use.

(The Director doubtless means one-half of all we consume.)

In his report for 1911 Director Cooke said:

From a study of the results obtained from other cities . . . there is hardly a doubt that, if meters were placed on those properties wherein waste is detected, the consumption would be so reduced that a good supply could be maintained in all sections of the city.

In short, the Department was aware that the use of meters would render the present supply absurdly ample for all the city's needs, for years to come. It is therefore, to put it mildly, disquieting to find the Department now nearly silent on the subject of waste restriction, and to hear Director Cooke publicly quoted as saying that the present supply must speedily be augmented, as favoring the bringing of additional water from distant sources, and as having asked the City Councils for an appropriation of \$15,000 for the employment of experts to advise him in this connection. It is difficult to understand this abrupt and unfortunate change of base; but it may be well to remember the method adopted in the attempted introduction of meters.

Instead of installing meters at the city's discretion, and at the city's expense, the department merely made their use permissive, the consumer paying for the meter, hoping thereby to reduce his water bills. Under this arrangement, of course, meters were installed only, or chiefly, by "those just persons who needed no repentance," persons who wasted little or no water. The result of course was that the city revenue was reduced, without corresponding diminution of waste, and the meter system was brought into undeserved disrepute, to the joy of those who seek to profit by the city's historic plight.

Another fellow suburbanite recently pointed to the present European War as evidence of the alleged fact that the world has too much government, whereas, what the world needs for the prevention of such world nuisances, is a strong world-government, both ready and able to squelch promptly any upstart nation which might elect to derange the world-organization by playing soldier on its own account; and in Philadelphia we need a government which, taking its stand upon the City Charter, will meter the water supply, without a "by your leave" to our ignorant hoi polloi or to its representatives in the municipal legislature.

Mr. Fulton mentioned that, when the city of Yonkers set about utilizing a certain source of water supply in its vicinity, it found that the city of New York had already preëmpted that supply. Now it is not for us suburbanites to instruct the Metropolis in the

conduct of its affairs, but this statement of Mr. Fulton's indicates the need, in New York State, of some super-municipal administration of water supplies, on the lines of that created by our ever progressive brethren of Massachusetts.

Think of the absurdity of permitting New York City to provide itself with a water supply from within the state, not only without providing for the distribution of that supply among the cities and towns along the line of its conduit, but actually helping itself to a supply which it now appears belongs naturally and properly to one of those towns! What is the state for, if not to prevent such outrages?

As municipal water supply superseded the old-time individual water supply, under which each consumer drew partly from his neighbor's supply, and, incidentally, also from his neighbor's cess-pool; so, the speaker ventures to predict, municipal water supply, a game of "Catch-who-catch-can," will be generally superseded, first by interurban water supply, as in the case of Boston and its surrounding communities, then by the state and interstate administrations, and, eventually and logically, by national, and finally by international water supply administration.

MR. ALLEN HAZEN: Mr. Trautwine's remarks on the Massachusetts control of waters are very interesting. Mr. Cuddeback and some others have been having experiences like that lately, and find that this makes it difficult for cities and towns to get water, which would be easily available if it were not for the state supervision as now conducted.

MR. JOHN C. TRAUTWINE, JR.: Mr. Hazen's statement that state control of waters in Massachusetts sometimes "makes it difficult for cities and towns to get water, which would be easily available if it were not for the state supervision as now conducted," is not at all surprising. It is even probable that the projectors of the New York City supply thought it best for the public welfare that there was no New York State authority to interfere with their designs upon Yonkers and her little ewe lamb.

Doubtless, after the Revolutionary War, when the original thirteen states had formed their "more perfect union," individual states now and then found that, in certain cases, the new Union made it difficult for them to get things which would have been easily

available if it had not been for the Union as then conducted; but probably everyone now recognizes that the benefits accruing to each of our states, by virtue of its present membership in the Union, vastly outweigh any possible inconvenience or loss of prestige or "identity" which that membership may entail.

Under the present "economic" system, which puts its premium upon self-seeking, it is only to be expected that each new adventure in further socialization will fail to work quite smoothly at first; but, in the long run, we do not generally find that, where such adventures have been made and carried out in the proper spirit, there has been general clamor for a reversion to the ancient rule of "every town for itself, and the devil take the hindmost."